

MISSOURI MONTHLY VITAL STATISTICS

Provisional Statistics

From The

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Focus. . . Smoking During Pregnancy: Missouri Longitudinal Study 1989-1997

Maternal smoking during pregnancy has been shown to be associated with reduced birth weight and increased fetal and infant mortality. This was shown in an original study of 176,843 Missouri maternally linked singleton first and second pregnancies from 1978 to 1990.⁽¹⁾ The current study represents a follow-up of this study involving 98,919 maternally linked first and second singleton pregnancies from 1989 to 1997. Since 1989, the Missouri standard birth certificate includes a more refined measure of maternal smoking status, plus additional variables. The new certificate records the number of cigarettes smoked per day by the mother instead of the previous response categories of less than a pack or more than a pack.

The Missouri linked data set was developed by linking higher order live births and fetal deaths from 1989 to 1997 to lower order live births and fetal deaths using probabilistic linkage procedures. From this sibling file, 99,675 linked first- and second-order singleton pregnancies (live births and fetal deaths 20 weeks or more gestation) for Missouri resident women were extracted. This represented 88 percent of the attempted linkages in which the targeted first birth was a live birth compared with 87 percent in the 1978-1990 files. Maternal smoking status was available for both pregnancies for 98,919 of the linked siblings (99.2 percent), which represents a significant improvement from the 95.9

percent completeness percentage in 1978-1990. This improvement reflects the fact that smoking during pregnancy became a national data item available to all states in 1989.

Results

As in the first study, smoking during pregnancy was more prevalent in the second pregnancy (19.2 percent) than in the first (17.6 percent). Both figures represent reductions of about 30 percent from the 1978-1990 study. As Table 1 shows, 14.3 percent of women during the 1989-97 period smoked in both first and second pregnancies and 77.5 percent did not smoke in either pregnancy. While 3.3 percent of the study mothers smoked in their first pregnancy only, slightly more (4.9 percent) smoked in the second pregnancy only. Looking at these figures a little differently, 18.7 percent of those who smoked in their first pregnancy quit by the second and 81.3 percent of those who smoked in the first also smoked in the second. Of those not smoking in the first pregnancy, 5.9 percent started by the second pregnancy.

The quit rate of 18.7 percent in 1989-1997 represents an increase from the 16.6 percent in 1978-1990 and the start-up rate of 5.9 percent is a decrease from the 7.9 percent in the earlier study. This pattern of increasing smoking quit rates and decreasing start-up rates between the first and second

(continued on next page)

Table 1
Percentage of Women Smoking Cigarettes in First and Second Pregnancies by Selected Characteristics: Missouri 1978-90 and 1989-97

<i>Pregnancy</i>		<i>Total</i>		<i>Black</i>		<i>Non-black</i>		<i>Mother <20</i>		<i>Mother >20</i>	
<i>1st</i>	<i>2nd</i>	<i>1978-90</i>	<i>1989-97</i>	<i>1978-90</i>	<i>1989-97</i>	<i>1978-90</i>	<i>1989-97</i>	<i>1978-90</i>	<i>1989-97</i>	<i>1978-90</i>	<i>1989-97</i>
Did not smoke	Did not smoke	68.4	77.5	67.4	87.7	68.5	76.0	54.7	67.0	74.1	81.9
Smoked	Did not smoke	4.3	3.3	3.7	1.6	4.4	3.6	4.6	3.8	4.1	3.1
Did not smoke	Smoked	5.9	4.9	8.4	4.9	5.5	4.9	10.7	9.2	3.8	3.1
Smoked	Smoked	21.5	14.3	20.6	5.9	21.6	15.6	30.1	20.0	17.9	11.9
Smoked in 1st pregnancy		25.8	17.6	24.2	7.4	26.0	19.2	34.6	23.7	22.0	15.0
Smoked in 2nd pregnancy		27.4	19.2	29.0	10.7	27.1	20.5	40.8	29.2	21.8	15.0
Percent who quit by 2nd		16.6	18.7	15.1	21.1	16.8	18.6	13.3	15.8	18.7	20.6
Percent who started by 2nd		7.9	5.9	11.1	5.2	7.4	6.1	16.4	12.1	4.9	3.6
N		176,843	98,919	22,358	13,350	154,485	85,559	52,191	29,057	124,633	69,847

pregnancies was greater among blacks than non-blacks (See Table 1). The overall smoking rates dropped by about two-thirds between the two study periods for black women and one-quarter for non-black women.

Factors increasing the quit rate include getting married between pregnancies or having a bad

pregnancy outcome (fetal or infant death) in the first pregnancy. Women smokers unmarried in the first pregnancy, but married in the second had a 22 percent quit rate by the second pregnancy, while 25 percent of smoking women with a fetal or infant death in the first pregnancy quit smoking by the second pregnancy. Another factor changing the

Table 2
Relative risks of smoking status in first and second pregnancies on low birth weight (LBW <2500 g) small-for-gestational age (SGA) and fetal and infant mortality by type in second pregnancy (with non-smoking in both pregnancies for the referent group): Missouri 1989-97

<i>Smoking status</i>		<i>LBW</i>		<i>SGA</i>		<i>Fetal death</i>		<i>Neonatal death</i>		<i>Postneonatal death</i>	
<i>Pregnancy</i>											
<i>1st</i>	<i>2nd</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>
Smoked	None	1.38*	1.20*	1.63*	1.40*	1.70*	1.64*	0.50	0.54	0.97	0.88
None	Smoked	2.19*	1.91*	2.43*	2.12*	1.60*	1.46	1.49	1.44	2.72*	1.82*
Smoked	Smoked	2.33*	1.81*	3.06*	2.39*	1.33*	1.26	1.25	1.33	3.34*	2.42*

<i>Smoking status</i>		<i>Perinatal death</i>		<i>Infant death</i>		<i>Fetal or Infant death</i>	
<i>Pregnancy</i>							
<i>1st</i>	<i>2nd</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>	<i>Unadj.</i>	<i>Adj.</i>
Smoked	None	1.15	1.17	0.70	0.70	1.11	1.09
None	Smoked	1.55*	1.45*	2.01*	1.62*	1.85*	1.56*
Smoked	Smoked	1.29*	1.29*	2.14*	1.88*	1.81*	1.64*

*95 percent confidence interval does not overlap one.

Note: Adjusted relative risks calculated using multivariate logistic regression with the following covariates: race, education, and age of mother, marital status in each pregnancy, spacing since last birth, gender, WIC participation, mother's pre-pregnancy weight, previous fetal or infant death and birth weight of first pregnancy.

quit rate is amount smoked in the first pregnancy. Women smoking 1-9 cigarettes in the first pregnancy quit smoking by the second at a 27.8 percent rate compared to those smoking 10-19 cigarettes (16.2 percent) and those smoking 20 or more cigarettes (11.4 percent). Clearly the more a woman smokes, the more addicted she is, and the harder it is for her to quit.

birth weight, after adjustment for covariates for infants of mothers who smoked in both pregnancies was 3,272 grams or 173 less grams than those who smoked in neither pregnancy (3,445 grams). Infants of those who smoked in the second pregnancy only weighed an average of 3,277 grams, while infants of mothers who smoked in the first pregnancy only weighed 3,426 grams.

Table 3
Adjusted birth weights(grams) by smoking levels in first and second pregnancies:
Missouri 1978-90 and 1989-97

<i>Smoking level</i>		Adjusted Birth Weight/ 2nd Pregnancy		Difference in Adjusted Birth Weights/ 2nd Pregnancy*	
1st pregnancy	2nd pregnancy	1978-90	1989-97	1978-90	1989-97
None	None	3465	3445	0	0
< 1 pk per day	None	3485	3430	20	-15
> 1 pk per day	None	3497	3395	32	-50
None	< 1 pk per day	3329	3288	-136	-157
< 1 pk per day	< 1 pk per day	3312	3292	-153	-153
> 1 pk per day	< 1 pk per day	3263	3257	-202	-188
None	> 1 pk per day	3223	3237	-242	-218
< 1 pk per day	> 1 pk per day	3254	3250	-211	-195
> 1 pk per day	> 1 pk per day	3248	3237	-217	-218

Note: Adjusted using analysis of covariance with the following covariates: race, education, age of mother, marital status in each pregnancy, spacing since last birth, year of birth gender and mother's pregnancy weight for height. In 1989-97, WIC participation and previous fetal or infant death were also adjusted for.

*For each smoking level the adjusted birth weight in the second pregnancy is compared to the adjusted birth weight of the group that did not smoke in either pregnancy.

Change in marital status is also a factor in increasing the proportion of women smoking in the second pregnancy that had abstained in the first. About 25 percent of non-smoking women who were married in the first pregnancy, but unmarried in the second (usually divorced) started smoking by the second pregnancy compared with 7.9 percent overall.

As in the first study, birth weight in the second pregnancy was highly correlated with smoking status, regardless of smoking status in the first. The mean

Also consistent with the first study, mothers who smoked in the second pregnancy had infants with adjusted low birth weight (LBW, < 2,500 grams) and small-for-gestational age (SGA) rates approximately double those not smoking in second pregnancy, regardless of smoking in the first pregnancy (See Table 2). Smoking was more strongly associated with SGA rates than with the LBW rate. For those smoking in both pregnancies, the adjusted relative risk (RR) for SGA was 2.39 and 1.81 for

LBW compared with infants of mothers smoking in neither pregnancy. Second-born infants of mothers smoking only in the first pregnancy had RRs significantly higher than one for SGA (1.40) and LBW (1.20) compared with infants of non-smoking mothers in both pregnancies. This possibly could be related to undisclosed smoking in the second pregnancy or unavailable covariates.

The patterns of smoking RRs for mortality are less clear than for LBW and SGA (See Table 2). This is probably related to smaller numbers and the fact that there is less association between smoking and mortality than smoking and birth weight. For

mothers who smoked in neither pregnancy. The largest smoking RR (2.42) was in the postneonatal (28 days to 11 months of age) mortality group. This was primarily related to Sudden Infant Death Syndrome (SIDS) with an RR value of 3.40.

Tables 3 and 4 show the differences in adjusted birth weights and RRs for LBW, SGA and fetal and infant mortality, by maternal smoking levels. Generally, as in the first study, there was a close relationship of smoking level in the second pregnancy-to-pregnancy outcomes in the second pregnancy. Infants of mothers who smoked at least one pack of cigarettes per day in the second pregnancy

Table 4
Relative risks of smoking levels in first and second pregnancies on low birth weight (LBW <2500 g) small-for-gestational age (SGA) and fetal and infant mortality by type in second pregnancy (with non-smoking in both pregnancies the referent group):
Missouri 1989-97

<i>Smoking level</i>		LBW <u>Adj.</u>	SGA <u>Adj.</u>	Perinatal Death <u>Adj.</u>	Infant Death <u>Adj.</u>	Fetal or Infant Death <u>Adj.</u>
1st pregnancy	2nd pregnancy					
< 1 pk per day	None	1.19	1.35*	1.28	0.80	1.23
> 1 pk per day	None	1.27	1.67*	0.54	0.35	0.40
None	< 1 pk per day	1.82*	1.93*	1.31	1.59*	1.44*
< 1 pk per day	< 1 pk per day	1.66*	2.24*	1.17	1.73*	1.47*
> 1 pk per day	< 1 pk per day	2.22*	2.40*	1.71*	1.85*	1.96*
None	> 1 pk per day	2.22*	2.85*	1.59	1.59	1.71*
< 1 pk per day	> 1 pk per day	1.81*	2.44*	1.54*	2.78*	2.27*
> 1 pk per day	> 1 pk per day	1.95*	2.72*	0.88	1.53	1.26

*95 percent confidence interval does not overlap one.

Note: Adjusted relative risks calculated using multivariate logistic regression with the following covariates race, education, and age of mother, marital status in each pregnancy, spacing since last birth, year of birth, gender, WIC participation, mother's prepregnancy weight, previous fetal or infant death and birth weight of first pregnancy.

perinatal mortality (fetal deaths plus infant deaths under 28 days of age) and infant mortality (death before first birth day), infants of mothers who smoked in their second pregnancy had RRs significantly greater than one. For fetal and infant mortality combined, the RR for infants of mothers who smoked in both pregnancies was 1.64 compared to infants of

had adjusted RRs for LBW and SGA ranging from 1.81 to 2.85 compared to non-smoking mothers. Infants of mothers who reduced their smoking levels from one pack or more per day in the first pregnancy to less than a pack per day in the second had RRs similar to those smoking a pack or more per day in the second pregnancy. Despite the reduction in

smoking from the first to the second pregnancy, the RR values for this group were considerably higher than for other infants with mothers smoking less than a pack per day in the second pregnancy. Infants of mothers who quit smoking altogether by the second pregnancy had RRs slightly above one, but much less than infants of mothers who smoked in the second pregnancy.

Discussion

The results of this longitudinal-maternally-linked pregnancy study among Missouri pregnancies 1989-1997 generally support the findings of the earlier 1978-1990 study, with the sharp decrease in maternal smoking rates of nearly one-third being the major change. In both study periods, more women smoked in their second pregnancy than in their first, as more started smoking after not smoking in the first pregnancy than those that stopped smoking by the second pregnancy.

As with the previous study, smoking in the second pregnancy was associated with a decreased birth weight of nearly 200 grams and a doubling of the risk for LBW and SGA. The relationship was stronger for SGA than LBW, as smoking apparently affects birth weight more than gestational age. Smoking in the second pregnancy increased the risk of a fetal or infant death by 50 to 60 percent, with an increased risk of postneonatal death being the largest risk by age. This is probably partly related to second-hand smoke from the mother and/or the father.

Results by amount smoked showed a definite dose-response relationship, with heavier smoking by mothers in their second pregnancy leading to even lower birth weights. Infants of mothers who

smoked a pack or more per day in their second pregnancy had birth weights more than 200 grams less than non-smoking mothers and about 50 grams less than infants of mothers who smoked less than a pack per day during pregnancy. Reducing amount smoked between pregnancies had much less impact than quitting altogether.

In summary, this study again demonstrates the benefits of smoking-cessation between pregnancies. However, more than 80 percent of those who smoked in their first pregnancy also smoked in their second. While overall smoking rates dropped by one-third between the two study periods, quit rates between pregnancies only increased by 12 percent. There is some evidence that change in marital status affects smoking behavior during pregnancy. Women who divorce after their first pregnancy are more likely to start smoking by their second pregnancy. On the other hand, women who are unwed in the first pregnancy but married by the second are most likely to quit. Women who experience a fetal or infant death are also more likely to quit smoking by the second pregnancy.

Not starting smoking in the first place is still the best prevention strategy. However, for those who do smoke, physicians should strongly encourage these women to enter into smoking-cessation programs in order to benefit the health of both their current and future children.

References:

1. Schramm, W.F. Smoking during pregnancy: Missouri longitudinal study. *Paediatric and Perinatal Epidemiology*, Vol. 11 Supplement 1, January 1997, pp73-83. (condensed in *Missouri Monthly Vital Statistics*, January 1997, Vol. 30, No. 11).

Provisional Vital Statistics for September 2001

Live births increased in September as 6,137 Missouri babies were born compared with 5,751 in September 2000. However, cumulative births for the 9- and 12-month periods ending with September both decreased.

Deaths increased in September as 3,948 Missourians died compared with 3,701 one year earlier. However, cumulative death rates for January-September and the 12 months ending with September both decreased slightly.

The **Natural increase** in September was 2,189 (6,137 births

minus 3,948 deaths). The cumulative natural increase for the 9- and 12-month periods ending with September both show decreases.

Marriages decreased in September as 4,668 Missouri couples married compared with 4,955 one year earlier.

Dissolutions of marriage decreased for all three time periods shown below.

Infant deaths rates increased for all three time periods shown below. For the January-September, the infant death rate increased from 7.4 to 8.2 per 1,000 live births.

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Item	September				Jan.-Sep.cumulative				12 months ending with September				
	Number		Rate*		Number		Rate*		Number		Rate*		
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	1999	2000	2001
Live Births	5,751	6,137	13.5	12.8	57,974	56,852	13.9	13.5	76,960	75,727	13.8	13.8	13.5
Deaths	3,701	3,948	8.7	8.2	41,094	41,282	9.9	9.8	54,849	54,362	9.8	9.8	9.7
Natural increase...	2,050	2,189	4.8	4.6	16,880	15,570	4.1	3.7	22,111	21,365	4.0	4.0	3.8
Marriages	4,955	4,668	11.6	9.7	34,380	34,686	8.3	8.2	44,833	44,031	7.9	8.0	7.8
Dissolutions	2,334	1,901	5.5	4.0	19,970	18,908	4.8	4.5	26,209	25,402	4.4	4.7	4.5
Infant deaths	40	47	7.0	7.7	427	467	7.4	8.2	587	581	7.4	7.6	7.7
Population base (in thousands)	...	...	5,595	5,642	...	...	5,595	5,642	...	...	5,535	5,583	5,630

* Rates for live births, deaths, natural increase, marriages and dissolutions are computed on the number per 1000 estimated population. The infant death rate is based on the number of infant deaths per 1000 live births. Rates are adjusted to account for varying lengths of monthly reporting periods.

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